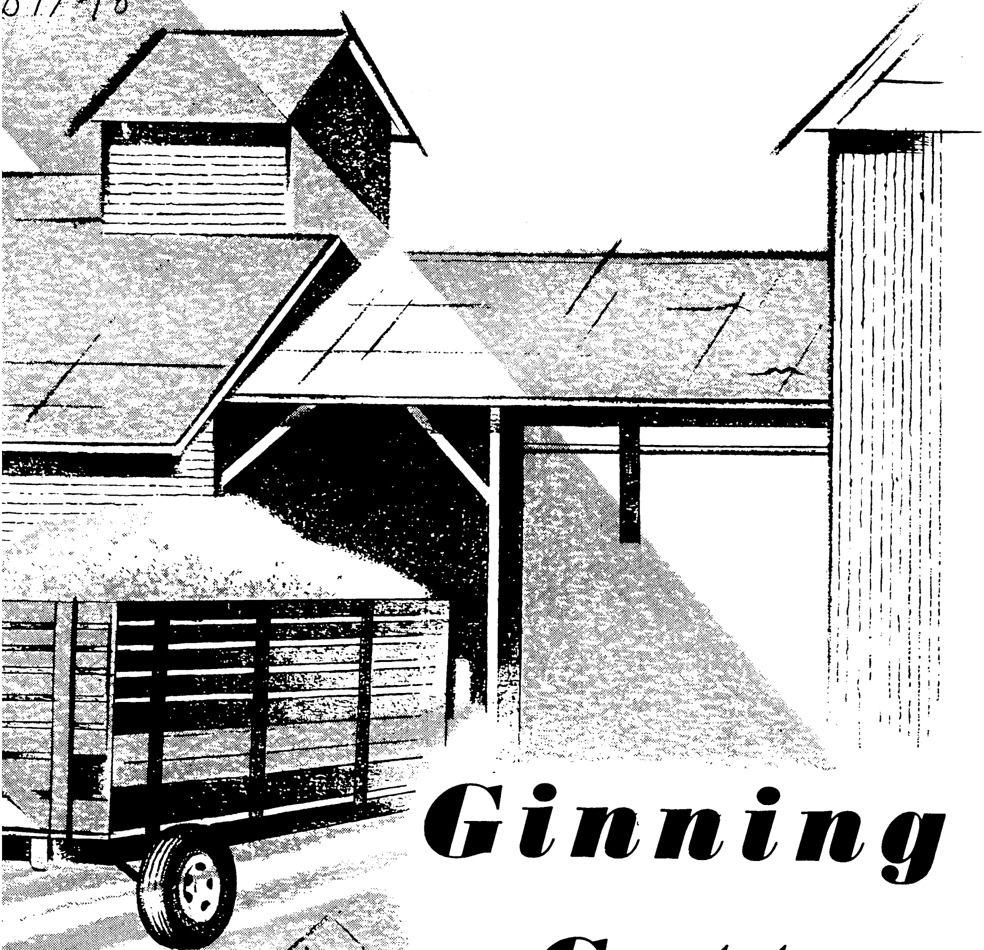
FARMERS' BULLETIN No. 1748



Ginning Cotton

UNITED STATES DEPARTMENT OF AGRICULTURE

CONTENTS

Washington, D. C. *Revised November 1956*

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 30 cents

Ginning Cotton

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Proper ginning equipment and methods can preserve the good qualities in cotton brought to the ginning plant. The cost of such service is usually outweighed by the increase in price received for the lint. With the present-day gin machinery in the modernized and more elaborate types of gins, it is frequently possible to produce lint from roughly harvested cottons that is almost equal to lint formerly produced from hand-picked cottons. For quality results, a farmer should endeavor both to pick cotton carefully and to handle it properly en route to the gin.

When harvested, cotton usually contains dirt, hulls, leaf fragments, and other foreign matter that must be removed either in the field or at the cotton gin, if the ginned lint is to have the highest market value. In ginning, moisture content of seed cotton also is important. If it is too high, ginning will damage the quality of the cotton unless it is artificially dried before being ginned. If the moisture content is too low, the fiber length may be shorter than normal unless the cotton is conditioned to the proper moisture content before ginning.

Cotton ginning processes have gradually expanded to include drying or conditioning, cleaning, extracting, feeding, ginning, lint cleaning, and packaging as distinct stages.

The ginner is the key man in most cotton communities. Some 200 cotton producers on the average look to him for a wide range of services associated with ginning and the sale of the crop. They also depend on him for protecting the purity of their planting seed from adverse variety mixtures and for sterilizing the seed where necessary.

Farm Practices Affect Ginning

It is seldom realized that farm practices seriously affect many of the ginning processes. For example, weed control and methods of cultivation affect the quantities of grass, vines, and other foreign matter that may be harvested with the crop. Sometimes troublesome deposits and residues, such as honeydew, arise from insect infestation, which may also require quarantine sterilization apparatus.

Varieties of cotton differ greatly in their potential neppiness and difficulty of ginning. Time of harvesting affects those quality elements that suffer from field exposure, moisture, and weather damage. Types of mechanized harvesting, rough hand snapping or hand pulling, and methods of handling from field to gin produce numerous gin-process problems.

The wide range in moisture content of the various loads of seed

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[1] This is a revision of Farmers' Bulletin 1748, prepared by C. A. Bennett and by F. L. Gerdes, formerly cotton technologist, Cotton Branch, Production and Marketing Administration.

Acknowledgment is made to the staffs of the U. S. Cotton Ginning Research Laboratories and to American manufacturers of cotton ginning machinery for their courteous and helpful assistance.

cotton brought to the gin makes drying control very difficult. And the ease or difficulty of turning out quality lint may depend on the way the grower handles his damp seed cotton—whether he stores it and dries it out (a hazardous, expensive, and sometimes unprofitable practice) or whether he delivers it to the gin as it was picked. These are but a few of the farm practices that affect the ginning process.

Ginning Processes Affect Turnout and Quality

Turnout is the baled fiber weight produced by ginning a load of seed cotton; that is, the yield of lint from the ginning of a given quantity of seed cotton. Varieties of cotton differ greatly in their inherent percentages of fiber and seed weights.

Turnout may be expected to decrease as the extent of processing through the stages of ginning increases. Quality, as indicated by the official standards for cotton grades, is obtainable when the moisture content of the fiber is relatively low (between 5 and 8 percent) and the staple length is uniform.

Maximum turnout frequently conflicts with optimum quality, because maximum weight to the bale can be obtained only by retaining some undesirable foreign matter and moisture and by resorting to such objectionable methods as tight-roll ginning.

In general, most of the ginning treatments that improve the quality elements of cotton fiber bring a profit to the producer, although the turnout may be less. Drying, which may reduce the fiber weight by 3 percent or more, frequently affords a net benefit up to $10 per bale. Cleaning and extracting processes, which may reduce the fiber weight by 10 percent or more, often yield net benefits as high as $20 per bale. Loose-roll ginning methods generally increase the value of cotton from 65 cents to as much as $2.50 per bale. These estimates are based on 1954 price levels.

Figure 1 shows the major stages of producing, handling, and gin processing of cotton. Those processes that are identified as drying, cleaning, and extracting may be employed in different manner and with different apparatus in each of the special stages where they are employed.

Ginning Defects Limit End Uses of Cotton

Such spinner terms as "tensile strength," "fiber length uniformity," and "neppiness" have become familiar to ginners, because these important elements of quality can be significantly affected by the ginning methods and processes.

Neps are small knots in cotton fiber. They are not found in unpicked cotton, but they occur in varying numbers in ginned lint and in all the products of the processes through which the raw cotton passes in the manufacturing of yarn. Certain ginning and cotton mill practices increase the tendency of cotton to show increased neppiness in yarn and fabrics.

Neppiness also varies with the cotton variety and with environment. The number of neps in yarn tends to increase with increases in fiber length, with increases in percentage of thin-walled fibers, and with decreases in fiber weight per inch.

The occurrence of neps in abundance in yarn affects the quality of the cloth manufactured from it. Neps detract from the general evenness of the yarn and appear as specks or irregular places in the

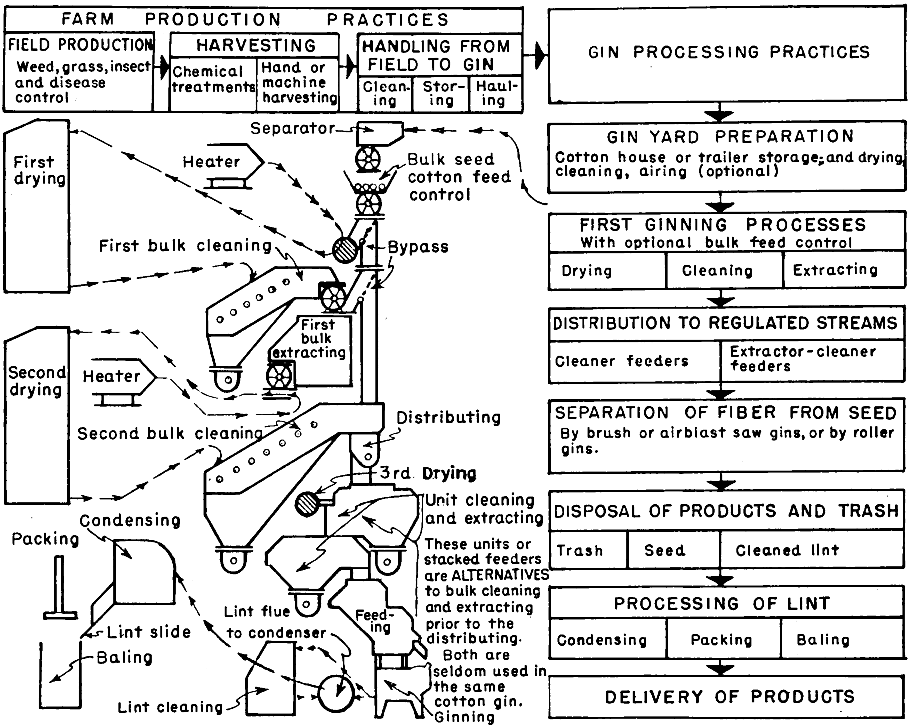

Figure 1.—**Composite diagram from many cotton gins, and flow sheet of farm-production practices and customary cotton ginning processes that may affect, or be involved in, the ginning of cotton.**

woven fabric. Most neps are composed of thin-walled fibers. Thin-walled fibers absorb less dye than do those that are thick walled. Consequently, neps appear in certain types of dyed cloth as light specks. Such cloth is considered inferior in quality to that of evenly dyed fabrics. Neps may also produce weak places in the yarn.

Other yarn and fabric imperfections similar to those associated with neps are caused by seedcoat fragments being chipped in the ginning processes. Tufts of fiber are still attached to the fragments. Also, small particles of thin-walled fibers in whole motes or crushed motes that escaped the ginning processes have a tendency to produce yarn and fabric imperfections similar to those associated with neps or with tangled fiber masses.

Variety and environmental conditions affect fiber length, length uniformity, strength, fineness, and maturity. However, the properties of fiber length, length uniformity, and tensile strength may be modified by practices at the cotton gin that are employed in conditioning, cleaning, and ginning of the seed cotton. Fiber tensile strength generally is the most important of these fiber properties from the standpoint of variation in yarn strength, and it may be affected adversely by excessive drying. Grade and then length are of significance in spinning value.

One element of spinning quality that may be held constant or lowered in ginning processes is that of manufacturing waste. Harvesting methods may also affect waste, but variety and place of growth have

little influence. Manufacturing waste is usually associated directly with the grade of the cotton.

Rough ginning is more familiar to the producer than any other type of fiber damage. It lowers the grade and value of cotton through increased neppiness or an abundance of large tangled masses of fibers. Rough ginning is caused mainly by ginning cotton in a damp or wet condition or by ginning with dense seed rolls. Either fast feeding to increase ginning capacity or restricting the passage of the ginned seed from the seed rolls to increase gin turnout will create dense seed rolls.

When cotton is ginned wet, the seed tends to chip and to produce seedcoat fragments. Ginning that causes dense seed rolls tends to chip the seed and to yield immature linters, which accompany the usable lint to the press. This practice detracts from the spinning value of the bale of cotton by increasing neps and manufacturing waste. Repeated passage of overflow cotton through overhead cleaning and drying machinery, the unnecessary use of extra machinery of this kind in cleaning cotton, and the overfeeding of machines tangle, or "rope," the seed locks and make the cotton rough or neppy.

Saw-cylinder lint cleaners located behind the gin stands that are pushed beyond their capacity may further increase neppiness caused by feeding of cotton to gin stands at a faster rate than the gin can accommodate smoothly.

Fiber length is seldom affected by ginning methods except when the cotton is brought in too dry or is overdried at the gin. However, when moisture content is lowered to as little as 2 or 3 percent, shrinkages of as much as one-sixteenth inch in fiber length may occur. On the other hand, cotton ginned with too high a moisture content may produce gin-cut fiber and cause the length to be penalized. Mechanical reductions in staple length frequently cause a lowering in the uniformity of staple length.

Fiber tensile strength may be adversely affected by too much drying at gins. Laboratory tests have shown that fiber tensile strength losses from overdrying usually average about 2,000 pounds—and seldom exceed 3,000 pounds—per square inch from single-stage drying at temperatures in excess of 250° F. or from comparable moisture reductions through multiple-stage drying at lower temperatures. Laboratory tests have failed to reveal losses of tensile strength attributable to any other process or malpractice in ginning.

Many modern ginning advantages are in evidence in the Cotton Belt. Modern gin cleaning and drying methods allow producers to adopt mechanical harvesting and other rough-picking methods that enable them to realize a satisfactory return on their operations. Ginners are also working to improve other elements of quality in cotton manufacturing. In the humid sections of the Cotton Belt some modern gins consistently produce grades of Strict Low Middling to Middling in comparison with grades of Strict Good Ordinary to Low Middling that were ginned in 1945 from machine-picked cotton. In the arid sections of the Cotton Belt grades on machine-picked cotton generally range from Middling to Strict Middling.

Regional Machinery Requirements for Ginning

Certain processes of farm handling and ginning of cotton are common to all regions. Also, mechanization of cotton production has tended to iron out many of the previous differences in regional practices. Certain characteristics of the industry, however, vary from sec-

tion to section and have given rise to strictly sectional practices in storage, conditioning, and ginning of cotton.

Cotton Storage Facilities at the Gin

In some sections, storage of seed cotton on the gin yard is frequently necessary, either in trailers or structural bins. This storage permits a producer to accumulate a number of bales before ginning the lot or releases farm wagons and motortrucks quickly so that they may return to the field. It also enables the cotton gin to handle peak deliveries of machine-harvested cottons made by night and during weekends. Facilities are not recommended, however, as a catchall for storing odd lots indefinitely.

Studies of seed-cotton handling practices have shown that storage houses with the following provisions most nearly meet the needs of producers and ginners for a "cushion" for peak capacity ginning:

1. A means for drawing normal air through any bin of stored cotton.
2. An economical means for bin-to-bin transfers.
3. A means for easy unloading of motortrucks or other conveyances at any time with unskilled labor, and service piping for delivery of the stored seed cotton to the gin, or as an emergency measure, to the motortruck from storage.
4. A plan and situation of the storage house to permit expansion by end or wing additions without disrupting existing storage units.
5. Narrow bins to serve a large number of customers and of a capacity to hold full bales of seed cotton; that is, 220, 270, 325, and 440 cubic feet per bale for handpicked, machine spindle-picked, hand-snapped, and machine-stripped cottons, respectively.
6. A work hall, about 4 feet wide, extending the entire length of the house and opening to the unloading telescope at one end and to the wagon-fill blowbox at the other.
7. Location of the unloading shed so as to permit maximum use of the driveways and observation from the control office, as well as future expansion of the storage house.
8. Fan arrangement in relation to piping that will facilitate multipurpose handling; for example, the filling of one bin while another empties to the gin or wagon.

Plans for suitable rectangular and octagonal cotton-storage houses, and planting seed-storage house with recommended dimensions, are shown in figures 2 and 3.

Mechanization practices since 1950 have introduced the use of demountable trailer bodies that hold from 3 to 5 bales of seed cotton and may be left at the gin lot while the chassis and empty spare bodies are returned to the harvest field. By this method, tarpaulins and shelter sheds replace protection afforded by gins. Use of these trailer bodies also eliminates expensive unloading and storage handling.

A gin yard dolly and tractor lift the trailer body and transport it to the suction pipe with less labor than previously needed for fixed storage, while fire hazards may be reduced by withdrawing any fire-packed loads.

The USDA Ginning Research Laboratories are producing economical methods for conditioning damp loads of trailer cotton while they wait for ginning. These usually comprise aeration by fans and by portable piping to built-in facilities on the trailers.

Overhead Ginning Processes

The following stages of drying, cleaning, and extracting—in prepar-

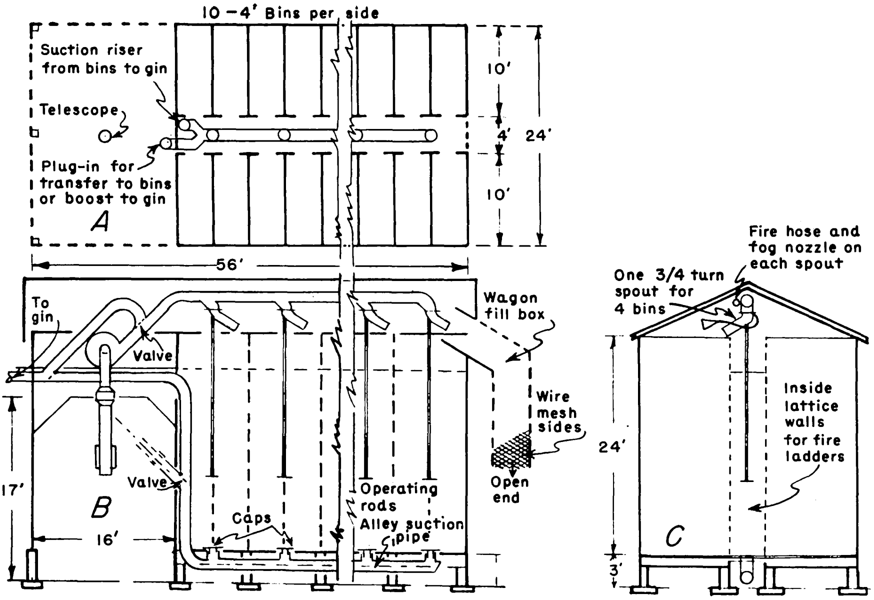

Figure 2.—Diagrams of standard 100-bale rectangular storage house for seed cotton: *A,* Floor plan; *B,* longitudinal section with piping diagram; C, end section.

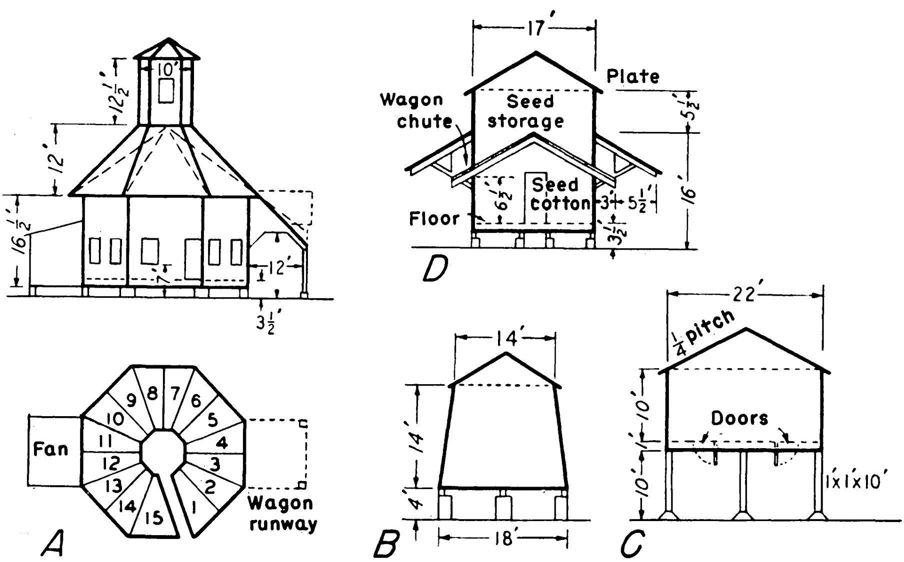

Figure 3.—Principal dimensions of other types of cotton-gin storage houses: *A,* Octagonal cotton-storage house; *B,* ground-level seed house; C, elevated seed house; *D,* combination seed and seed-cotton storage.

ing the cotton for the gin stands—are known as overhead processes, whether their machinery is actually located overhead or not.

DRYING

Adequate drying in rain-grown sections is the first requirement in improving cotton grades, as well as in ginning efficiently without chokages on mechanically harvested cotton.

Cotton driers and lint cleaners have achieved a place in the industry because of the returns that they yield to growers. It is estimated that about 6,000 gin plants were operating driers and more than 2,000 gins were using lint cleaners during the 1954 ginning season. Installation of these machines is indicative of their value to producers, despite the fact that their occasional abuse has led to some complaint by users and handlers of cotton.

Bulk feeding control devices introduced at cotton gins since 1950 materially assist in uniformity of flow and improve treatment of seed cotton throughout the drying and cleaning phases of ginning.

The drying process uses 40 or more cubic feet of heated air per pound of damp seed cotton. This means an exposure period of 12 seconds to 3 minutes, depending upon the type of drier used, and a temperature of 160° F. or more, to suit the dampness of the individual loads of cotton.

Tower driers are in common use (fig. 4). These range from 9 to 24 floors and customarily employ from 5,000 to 6,500 cubic feet of hot air per minute, depending upon spacings between floors. For single-stage drying, drier inlet temperatures to suit the drying needs and to preserve the cotton quality usually range from 180° to 250° F. For double-stage drying the second unit usually operates at 180° to 220°, where one drier serves the opening cleaner and the big-bur machine and the second unit performs drying for the finishing cleaner and the feeders. Other types of driers with mechanical agitation and conveying use similar volumes of heated air (fig. 5).

It is now a general practice of some machinery manufacturers to design their own driers for use in the first position and then to use a tower drier for the second stage of drying. Hot air, supplied to the gin-stand feeders, comprises a third stage of drying, but in small low-volume gins the feeders may incorporate the entire drying system.

CLEANING

The second major process in modern gins is usually that of bulk cleaning by means of threshing cylinders and concave screens. Machines for removing burs, sticks, grass, and stems, are indispensable. Recent public patent applications by the USDA Cotton Ginning Research Laboratories are introducing important new equipment such as a stick remover for these purposes. The necessary machines, operated in proper sequence, are highly beneficial in increasing both the grade and value of cotton. Optimum machine combinations properly operated, therefore, reduce the manufacturing losses in cotton mills.

The term "overhead cleaning" usually applies to bulk cleaning of the seed cotton before it reaches the distributor of the ginning system. In the latest of modern gins, this bulk flow from the storage bin or motortruck is mechanically regulated by a special feeding-control device. By means of this device the ginning operator can regulate the bulk flow of cotton through the driers, cleaners, and extractors en route to the distributor.

If the conveying currents of air pass through the body (not the screens) of the cleaner, the type of unit is said to be an "airline"

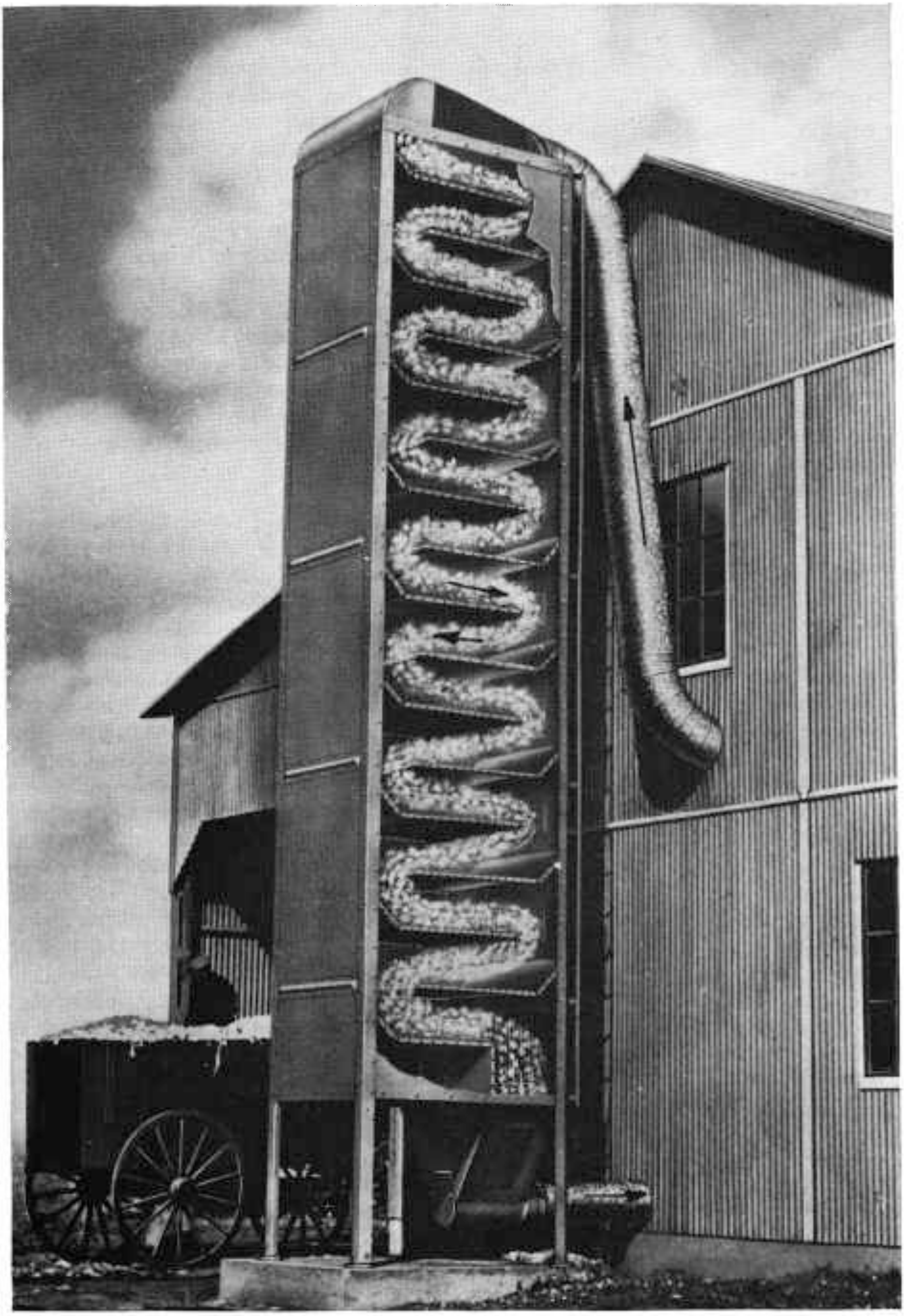

Figure 4.—United States Cotton Ginning Research Laboratory design of factory-built tower drier in cross section at a typical cotton gin. (Courtesy Gullett Gin Co.)

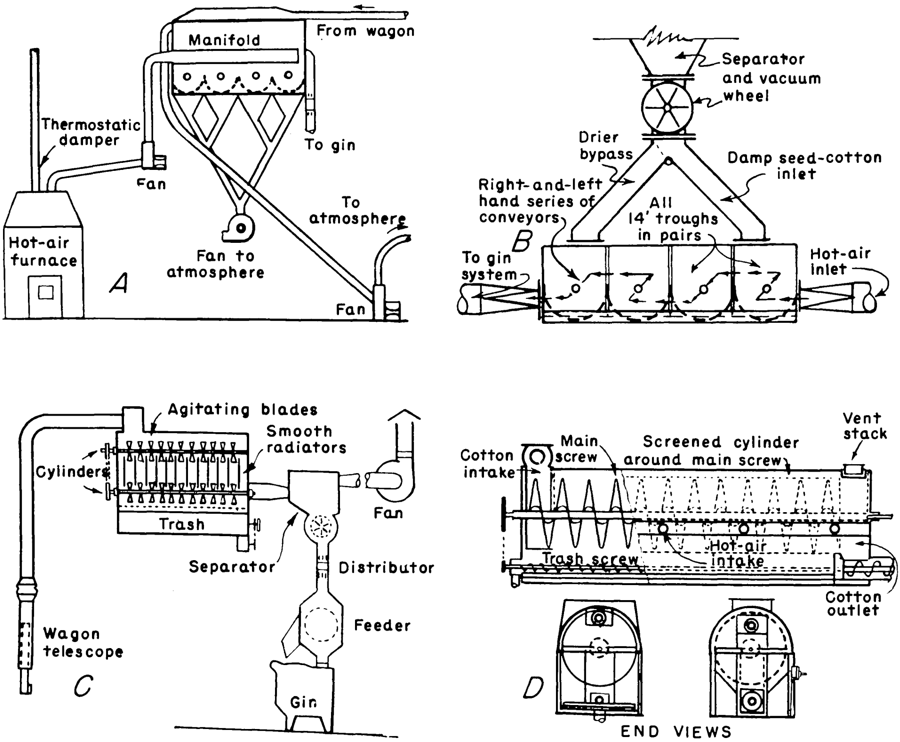

***Figure 5.*—Types of commercial bulk driers other than the Cotton Ginning Research Laboratory tower design: *A*, Fan-blade or paddle-wheel cylinder cleaner-drier; *B*, conveyor-distributor drier; *C*, thermo-cleaner-drier; *D*, big-reel cleaner-drier.**

cleaner. The flow of the air and cotton may be axial (along the shaft of the cleaner) or it may be at right angles to the cylinders as occurs in the cleaner shown in figure 6.

Gravity-type cleaners (fig. 7) may be converted to airline or airflow cleaners through the use of mechanical seals.

In recent years the older wooden-core cylinders of seed-cotton cleaners have been superseded by metal units, which vary considerably in design. This variation is shown in the cross-sectional views of eight popular kinds of cleaning cylinders now generally used at modern cotton gins (fig. 8). These cylinders, with modifications, may remove as much as 33 percent of the incoming foreign matter. The use of 6 to 24 cylinders of overhead cleaners, on hand-picked and mechanically harvested cottons, respectively, is general practice in modern cotton gins.

EXTRACTING

The third general seed-cotton treatment now common to modern cotton gins is extracting. The process of extracting removes large items of foreign matter by means of carding principles, whereas the cleaning process usually screens out fine trash, leaf particles, and small parts of stems. In extracting, a coarse-toothed drum, slow moving and of large diameter, seizes the seed-cotton locks while they are passed beneath a stripper, or vaned beater, which strikes off burs, sticks, stems, and other large pieces of foreign matter.

The extracting principle is applied to several stages of handling in the cotton gin. In the overhead proc-

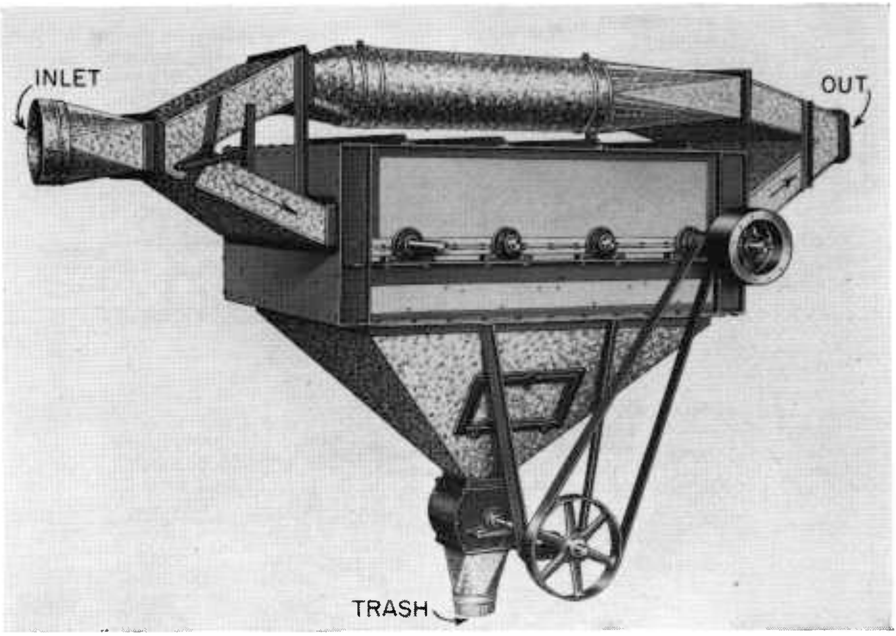

Figure 6.—**Airline-type seed-cotton cleaner, with an air-conveying current passing through the apparatus. Cotton and air enter at the upper left and leave at the upper right; trash is discharged at the bottom. (Courtesy The Murray Co. of Texas, Inc.)**

esses it is usually confined to one large unit from 8 to 14 feet long called a big-bur machine, or master extractor (fig. 9). After the cotton is distributed into regulated small streams for feeding the gin stands, extracting also occurs in the feeders and finally in the huller fronts of the stands. In an elaborate modern gin this series of extractions removes approximately 40 percent of the total incoming foreign matter; the recently developed USDA stick remover and cleaner removes up to 70 percent.

DISTRIBUTING

Modern saw gins now customarily utilize conveyor or auger distributors to distribute the seed cotton into feeders serving each gin-stand battery. Modern roller gins, because they handle long-staple seed cotton at relatively lower hourly rates than saw gins, have in some instances retained the pneumatic elevators that were common in the older plain gins. Sometimes special droppers with automatic controls are used to distribute the seed cotton to the roller gin stands.

Modern Cotton-Gin Process Combinations

After the cotton reaches the gin-stand battery the seed passes in one channel, the trash in another, and the ginned lint continues through a lint-cleaning process and thence to the condenser and bale press.

The methods of harvesting the seed cotton bear such important relations to the machinery necessary within the cotton gin that each change from clean hand picking to the various degrees of mechanical and rough hand harvesting may require progressively elaborate machinery to suit. Clean hand-picked seed cottons in all regions seldom require more machinery than the combination shown in figure 10.

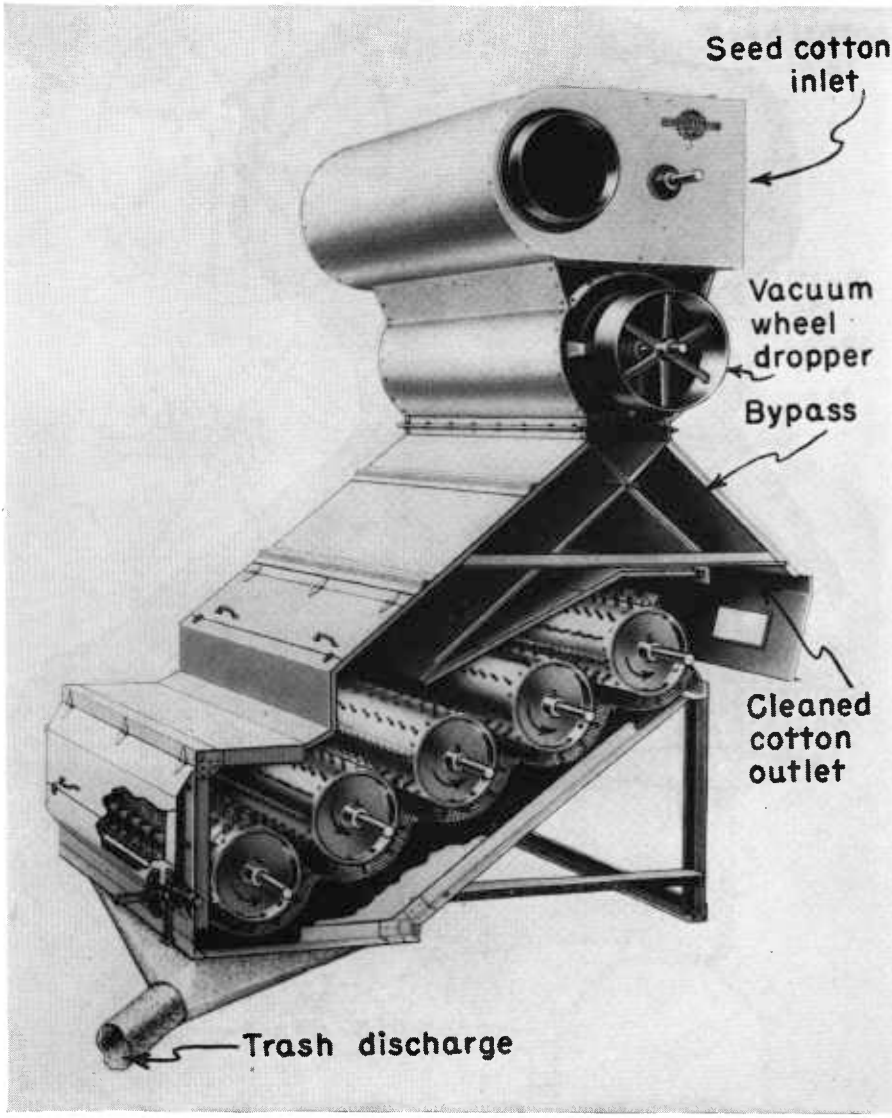

Figure 7.—Cutaway view of gravity-type seed-cotton cleaner in which the seed cotton is conveyed across the screen concaves by the beater cylinder. (Courtesy The Hardwicke-Etter Co.)

Slightly rougher harvestings than hand-picked cotton may be encountered in some sections. This kind of cotton may require additional treating equipment, such as a trap for rocks and green bolls and an extractor-feeder to replace the spiked cleaning feeder used in older gins (fig. 11).

Cotton picked by spindle machines and with transient labor generally contains considerable amounts of green leaf and some stems, a few sticks, and a few cotton burs. To take care of this cotton, the machinery for the major processes of cleaning and extracting may be situated in an annex or in an

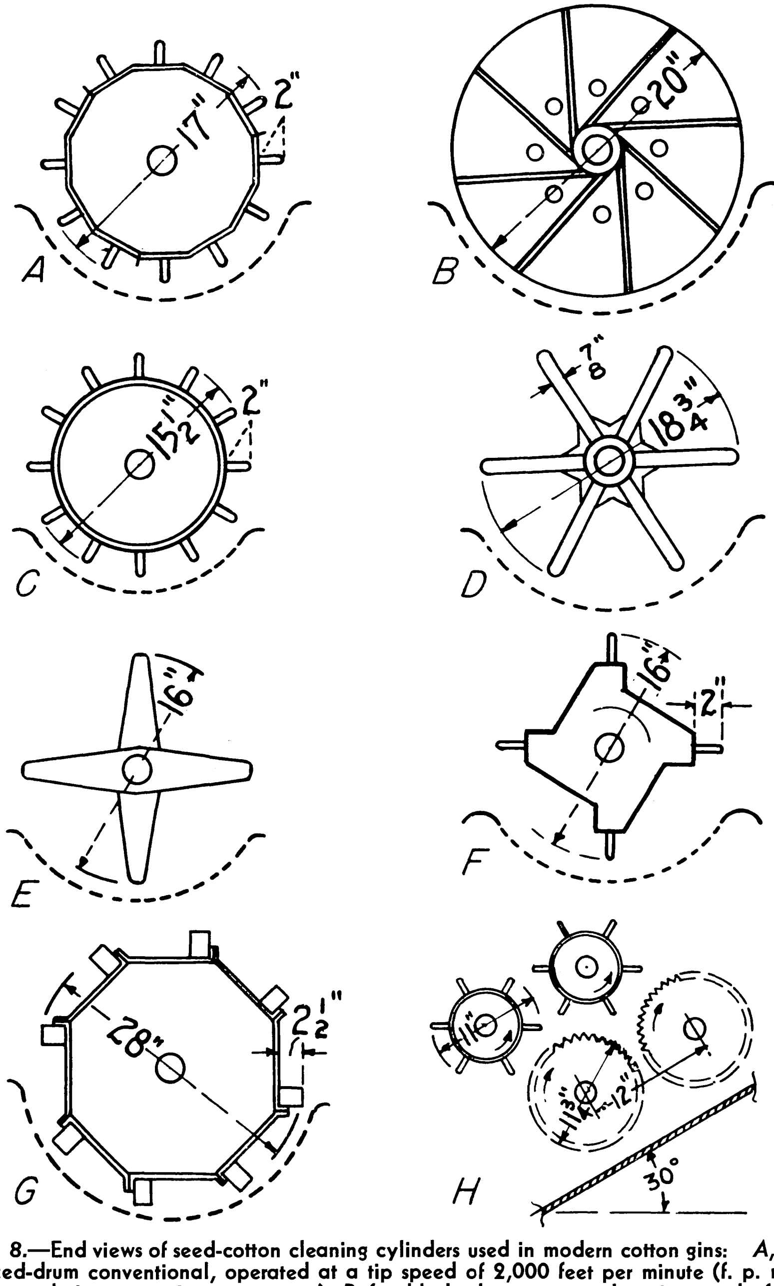

Figure 8.—End views of seed-cotton cleaning cylinders used in modern cotton gins: *A*, Large spiked-drum conventional, operated at a tip speed of 2,000 feet per minute (f. p. m.) (or 450 revolutions per minute—r. p. m.); *B*, fan-blade drum, operated at tip speed of 2,300 f. p. m. (550 r. p. m.); C, small spiked-drum conventional, tip speed 1,830 f. p. m. (450 r. p. m.); *D*, spider beater, and also airline-beater and opener for first cylinder, operated at tip speed of 2,200 f. p. m. (450 r. p. m.); *E*, airline-beater special-type cylinder, operated at tip speed of 1,880 f. p. m. (450 r. p. m.); *F*, composite fan and spike, operated at tip speed of 1,800 f. p. m. (450 r. p. m.); *G*, octagonal fan and fin, operated at tip speed of 2,200 f. p. m. (300 r. p. m.); *H*, spike-and-knuckle disk, so-called "impact," that uses no concave screen. Spike-tip speed of 1,730 and knuckle-tip speed 1,230 f. p. m.

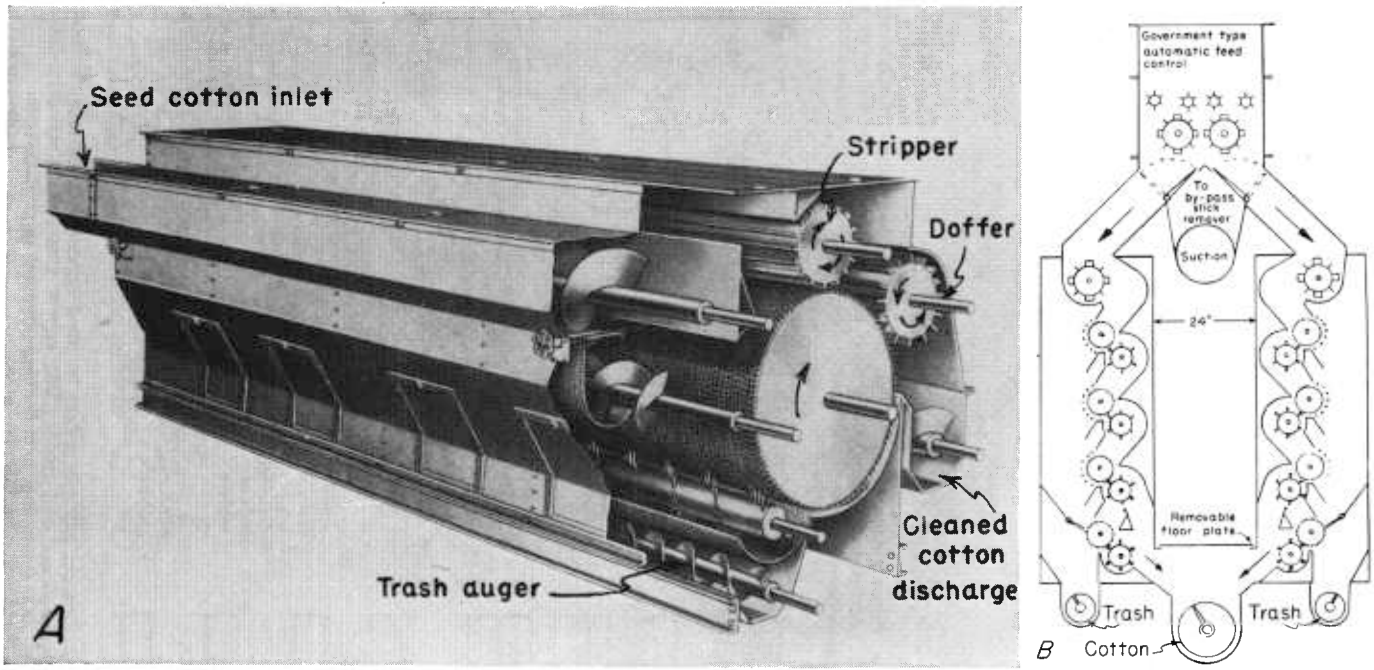

Figure 9.—Types of bulk flow extroctors: *A*, Cross section of a big-bur machine, or master extractor (courtesy The Hardwicke-Etter Co.); *B*, USDA design stick remover, or extractor-cleaner with bulk feed control.

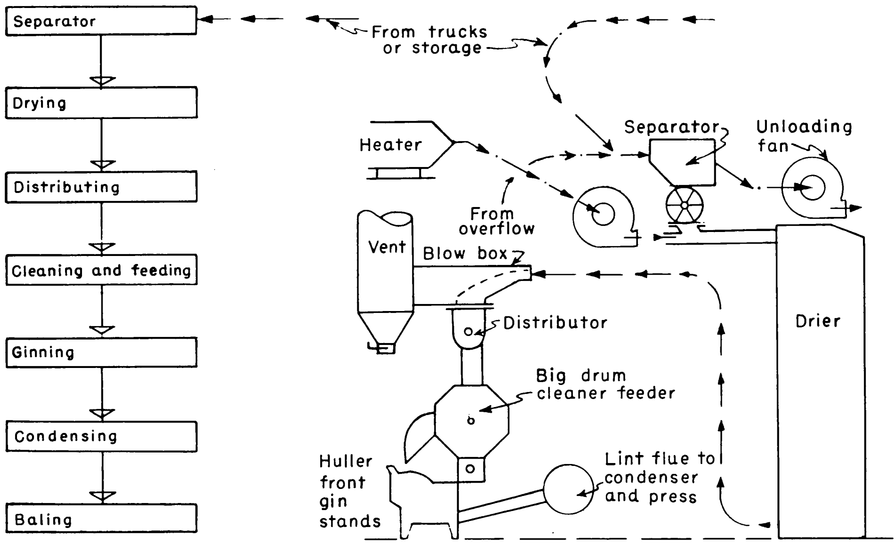

Figure 10.—**Flow diagram and end-elevation diagram of an approved minimum ginning system for clean hand-picked cotton. The drier may be either a draw-through type (not shown) or the blow-through type shown here. The feeders may be simple cleaning units.**

overhead group (fig. 12) or beneath the distributor for each battery (fig. 13). Suitable bypasses may be provided so that only the necessary machinery may operate to suit the needs of the individual bale. A big-

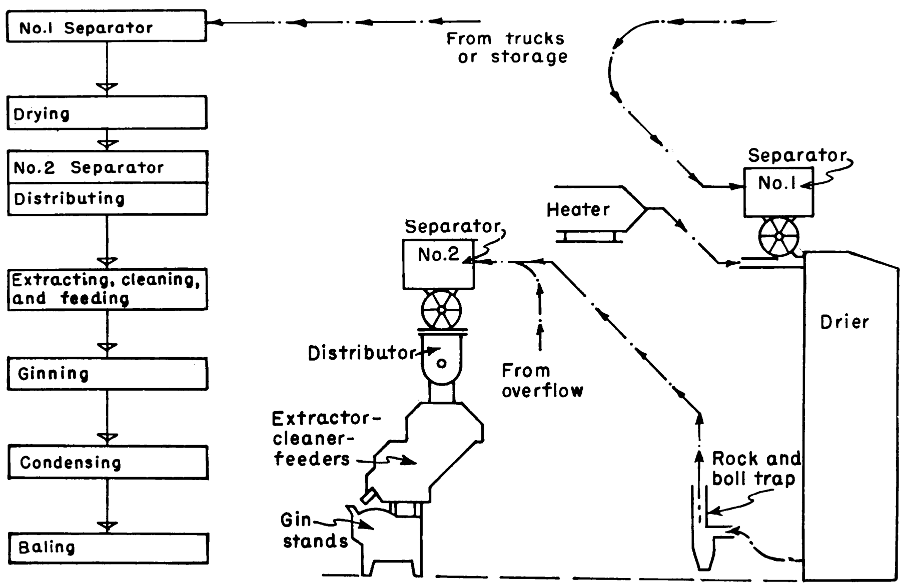

Figure 11.—**Flow diagram and gin system for hand-harvested cotton somewhat rougher than that which is hand-picked and clean. This system employs an extractor-feeder and a boll trap. The drier shown here is of the draw-through, or suction, type.**

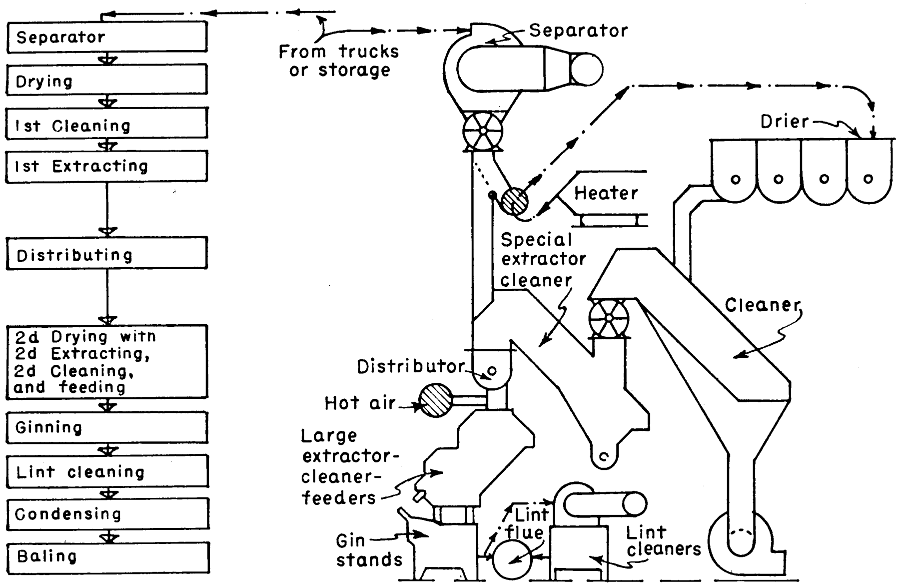

Figure 12.—Flow diagram and modern, all-purpose, medium-equipped, cotton gin system having overhead preliminary drying, cleaning, and extracting machinery. The cotton then goes to the regular ginning system that alone is usually adequate for cotton containing moderate moisture and picked (other than pulling and snapping) by transient labor.

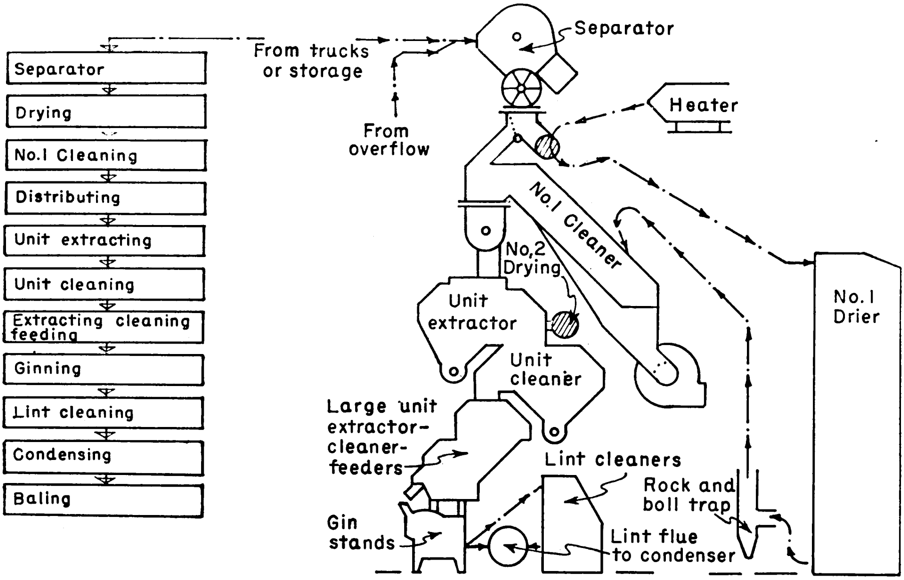

Figure 13.—Flow diagram and modern, all-purpose, medium-equipped, cotton gin system (alternative to that of figure 12), having only drying and overhead opening cleaner, but followed below the distributor with regulated cleaning, drying, and extracting equipment for each gin stand.

bur extractor is frequently substituted for the special overhead extractor-cleaner shown in figure 12.

In comparing figures 12 and 13 with figure 1, it will be seen more clearly that two distinct approaches to modern drying-cleaning-extracting processes now exist. The older method of preliminary overhead bulk drying, cleaning, and extracting—somewhat simpler than the composite of processes diagrammed in figure 1—consists of these steps only: First drying, first cleaning, first extracting, and second cleaning. Large-volume cotton gins with four or more gin stands generally use the method shown in figure 12. However, an increasing number of three-stand gins use the under-the-distributor method diagrammed in figure 13.

Neither of these moderate systems can fully cope with machine stripping, hand snapping, and hand pulling methods of rough harvesting that prevail in some sections. Consequently, a somewhat more elaborate ginning machinery setup is needed to take care of these cottons (fig. 14).

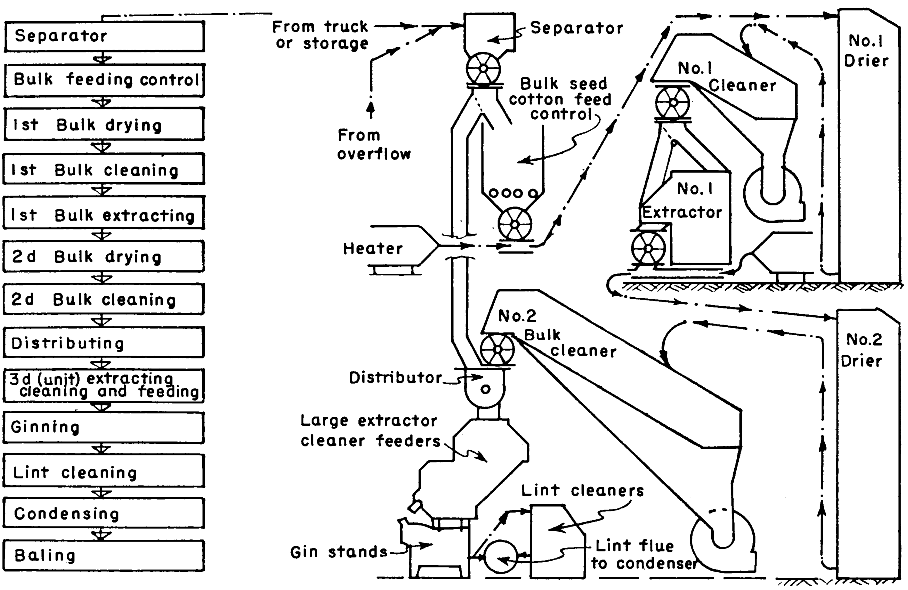

Figure 14.—**Flow diagram and cotton-gin machinery setup for rough-harvested cotton. This multidrying, multicleaning, and multiextracting gin can handle a wide range of seed cottons—from normal-clean to very rough-harvested types.**

Feeders

Hand methods of feeding from a flat shelf or hopper were originally employed for all types of gin stands, and are still employed in installations of hand-fed roller gins. Early in the twentieth century spiked or drum-type feeders were installed in saw and roller gins (fig. 15). They provided a uniform supply of seed cotton that could be controlled by the speed of the drum. About 1920, as ginning machinery began to improve, the feeders rapidly changed to extractor types. The addition of hot air to feeders was begun about 1933.

Addition of moisture by steam jets in feeders has, from time to

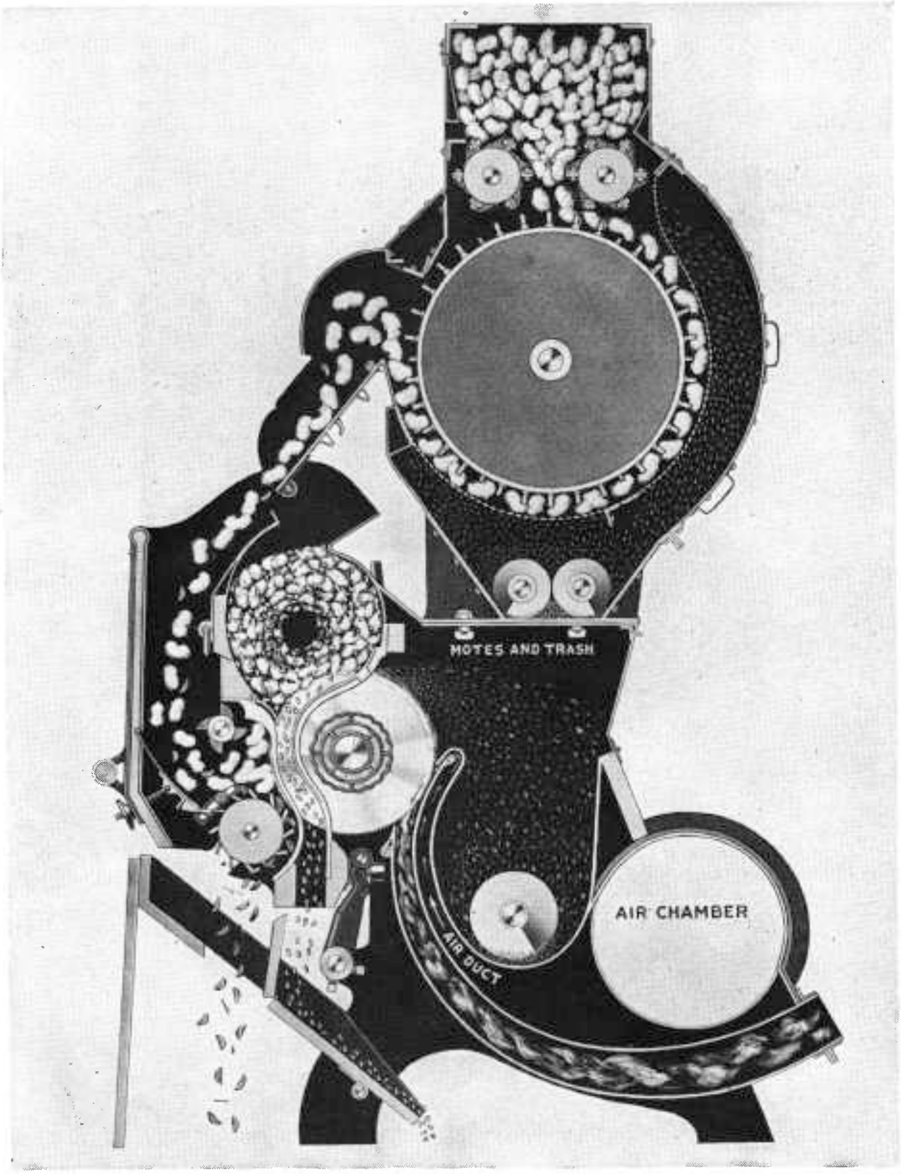

Figure 15.—**Drum-type feeder and saw-gin stand. (Courtesy The Murray Co. of Texas, Inc.)**

time, been practiced with varying degrees of success. But the practice is limited principally to arid regions or to elaborate ginning systems that may encounter overdried cotton.

Multiple or stacked feeders, to obtain more complete cleaning and extracting under one control device, also have been used in various cotton gins (fig. 16). The general objectives in both the duplicate and the special unit stacks are identical, but the resulting position of the distributor is different. In duplicated units (fig. 16, *A*), the distributor moves backward from the gin-stand front with the addition

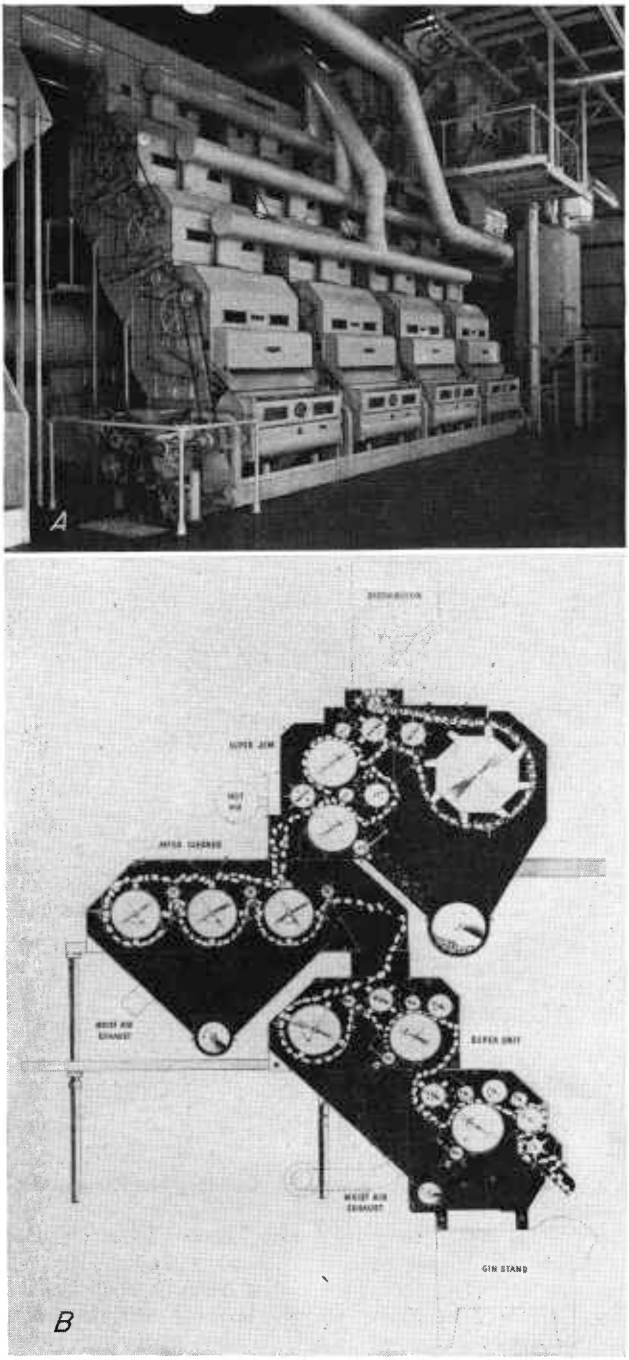

Figure 16.—Multiple or stacked feeders for saw gins: *A*, Duplicated units in tier (courtesy The Lummus Cotton Gin Co.); *B*, special units in tier (courtesy The John E. Mitchell Co.).

of each unit. With the addition of special units (fig. 16, *B*), the distributor may be raised vertically from its normal position on a plain feeder. A wide variety of other unit stacks now exists, varying in combinations as well as the number of units used.

By using the more recent forms of multiple or stacked feeders, the major stages of cleaning and extracting can be performed below the distributor. This system simplifies the control of feeding and avoids the use of more elaborate overhead and annex cleaning equipment. In emergency shutdowns, it has inconveniences of "dribbling" and slow cleanout.

Gin Stands

Two basic types of gins—saw gins and roller gins—are in use. In this country, practically all upland (fuzzy seed) cotton is processed with saw gins and the extra long staple slick seed (American-Egyptian and Sea Island types) almost entirely with slow ginning roller gins. Since upland cotton comprises more than 99 percent of total United States cotton production, saw gins predominate. Roller-type gins, few in number, are found in the United States only in communities where long-staple cotton is grown. One 90-saw gin usually has a capacity equal to about 7 roller gins of 40-inch length.

Types of Saw Gins

Two principal types of saw gins are in use today—airblast and brush. Each type includes a plain design or huller designs. In the plain design the seed cotton is fed directly into the roll box. In huller designs, now universally used in modern gins, the seed cotton is fed to outer or huller breasts having picker rollers designed to extract burs and trash (fig. 17). In the huller gins the gin saws draw the seed cotton from the picker roller of the huller breast through the huller ribs into the roll box.

The double-rib huller fronts predominate. The protection they give to the gin saws and their elimination of foreign matter, like burs, hulls, and leaf stems, have made them very popular. It is important to keep foreign matter from the seed roll so that the ginned lint will not be contaminated, which happens when the gin saws have to cut through a trash-laden seed roll in the ginning breast or roll box.

If rough trashy cotton like that harvested late in the season must be ginned, a huller gin will give the best results when the picker roller is set as far away from the huller ribs as possible. This adjustment permits a free discharge of foreign matter. If the trash does not discharge readily from the huller front, the gin saws drag in parts of it, the ginning capacity is reduced, chokages may follow, and a poor grade of lint is turned out. Then the part of the trash drawn into the roll box that does not go with the lint is discharged with the seed and lowers its value.

With the old-style plain gin it is highly advisable to install a master extractor or a unit extractor-feeder if trashy cotton is to be ginned. Addition of hot air to these units also enables them to perform more effectively.

The gins shown in figure 17 are all of the type that "mote by gravity"; that is, they cast off motes and some foreign matter into the spaces below the saws. Other efficient and economical designs of gins (see fig. 15) mote by centrifugal force, discharging the motes overhead between the back of the ribs and the brush or the airblast nozzle.

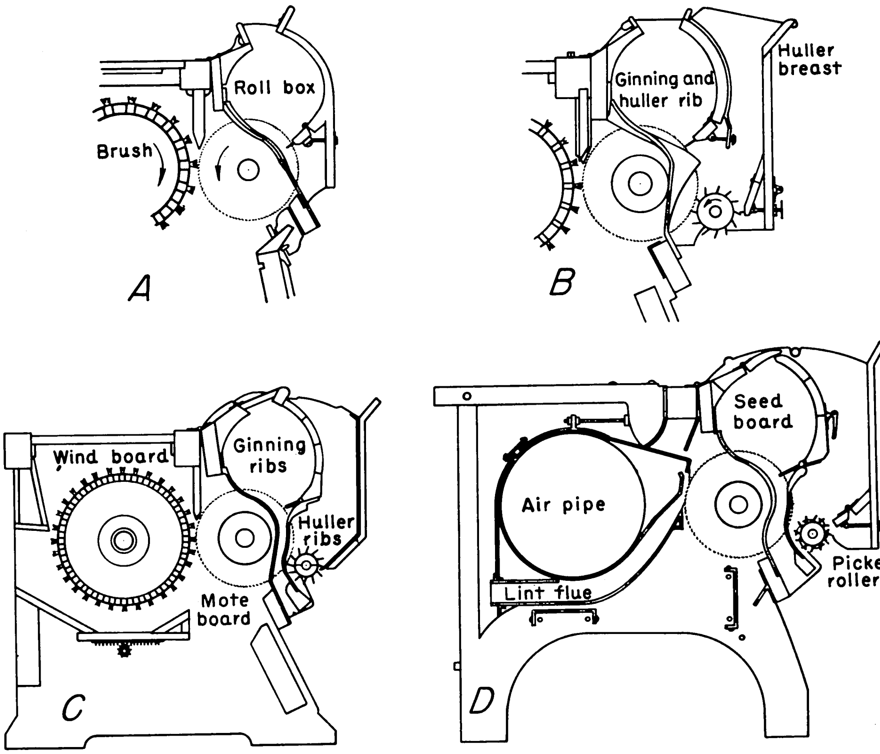

Figure 17.—Kinds of saw-gin fronts: *A*, Plain brush gin; *B*, single-rib huller brush gin; *C*, double-rib huller brush gin; *D*, double-rib huller airblast gin.

Rate of Feeding Saw Gins

The rate at which seed cotton is fed to the gin saws has an important influence on the quality of the lint produced. The cotton farmer pays dearly when he insists on crowding his cotton through the gin. Both the airblast and brush gins give a smoother and more valuable sample when the gin stands are fed so as to operate with loose seed rolls. Each gin-stand battery may handle from 20 to 45 pounds of seed cotton per saw per hour, depending upon the number and speed of the saws, the model of gin, and the variety and the condition of the cotton attributable to cultural and harvesting practices. The rate at which the seed cotton should be fed to the gin saws depends on the amount of moisture in the seed cotton, the length of the staple, the size and fuzziness of the seed, and other physical characteristics of the cotton. Long-staple cotton should be fed and ginned more slowly than short-staple cotton, and early season or damp cotton more slowly than dry cotton. A loose seed roll produces a smoother cotton than a tight seed roll. A ginner who is feeding the gin stands at the lowest rate and is still getting a rough sample can often improve it by slowing down his feeder drive. Setting the hinged seed board (fig. 17, *D*) wide open also helps, because it permits a good discharge of seed and thus contributes to a loose seed roll. An artificially tight seed roll can be produced by retaining the hinged seed board and its fingers in closed position.

Seed-Roll Density With Saw Gins

Samples ginned with a loose seed roll average from one-third grade to almost a full grade better than those ginned in the same way except with a tight roll. On some individual cottons the resulting lint is sometimes two full grades better. The amount of improvement attainable depends on the staple length and the moisture of the cotton. Using a tight seed roll not only lowers ginning preparation—1 of the 3 factors of grade—but also adversely affects the observed color and leaf—the other 2 factors of grade. Tight-roll ginning, therefore, should be avoided.

The advantages of loose-roll ginning combined with seed-cotton drying are worth considering. With the longer cottons that have a gross moisture content of 12 percent or more, drying the seed cotton and ginning with a loose seed roll yields a much better lint than can be obtained by ginning the same cotton without drying and with a tight seed roll.

Use of a loose seed roll has several advantages from a mechanical point of view. The loose seed roll requires less power, causes less wear and tear on gin saws and ribs, and causes less chokages and friction fires in huller fronts and ribs.

Gin-Saw Speed

Gin-saw speed is secondary to roll density in its effect on the quality of lint. To the ginner, however, gin-saw speed is more important as an effective means of volume ginning. In modern gins standard 12-inch diameter saws should maintain a speed of 650 to 700 revolutions per minute.

Mote-Board Adjustment of Saw Gins

The construction and the means for adjusting moting devices are varied, depending on the type and make of the gin stand. Brush gins are usually provided with movable mote boards placed below the brush in a horizontal or inclined position to form an extension to the bottom of the gin-flue [2] connection. Airblast gins usually have the equivalent of mote boards in the lower lip of the gin flue, which is located a few inches below the airblast nozzle. Gins that mote by centrifugal force do not have mote boards, but may have adjustable devices of various kinds so that the moting can be somewhat regulated mechanically.

In old model gins the mote board should be so adjusted that the undesirable substances commonly known as motes can be expelled readily from the lint without loss of good fibers. It is good practice to observe the moting action of the gin and keep the mote board set to suit the cotton as the season progresses. Adjustment should be checked by examining the press sample for motes and by observing the material cast off at the moting position.

Types and Operation of Roller Gins

Single- and double-roller types of roller gins are in use throughout the world. In the United States they are used almost exclusively for ginning long-staple cotton. The kinds of rollers and their dimensions are extensive.

The invention of the McCarthy roller gin in the United States in 1840 resulted in the worldwide adoption of its principle (fig. 18, *A*). Roller construction for power-driven, McCarthy-type roller gins varies from covered wooden cores to disks clamped on a shaft. Lengths of the ginning surfaces on these rollers are usually 40, 54, or 60 inches. The materials that cover the rollers may be strips of leather or any one of a number of compositions. The disks are usually leather.

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[2] Each saw gin has a gin flue that connects to the main lint flue of the system.

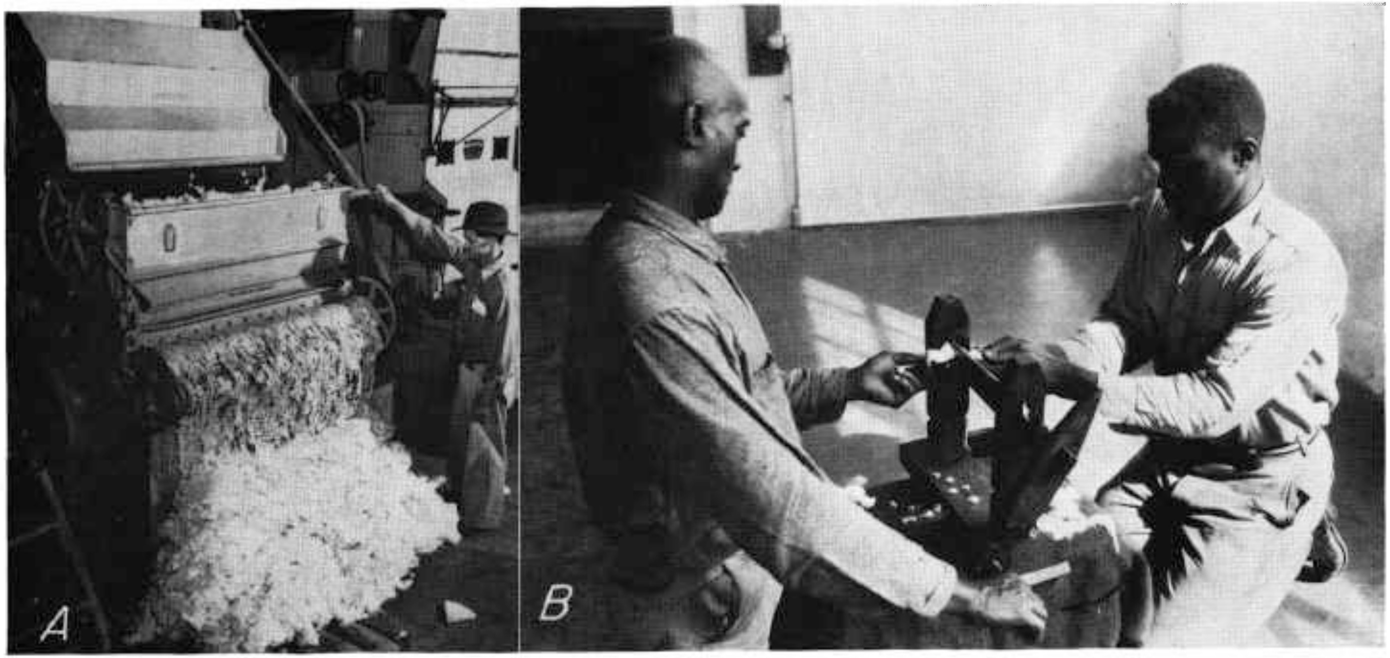

Figure 18.—Roller gins: *A*, Power-driven 40-inch roller, McCarthy type, with USDA doffing roller; and *B*, hand-operated Hindu Churka.

Careful adjustments must be maintained in roller gins so that the fixed knife or knives bear properly both as to pressure and position upon the rotating roller. The amount of overlap of the moving knife is also important in ginning, as the longest staples require the greatest overlap.

Speed of the rollers ranges from 90 to 150 r. p. m., 120 revolutions being well adapted to American-Egyptian and Sea Island varieties. Crank speeds range from 600 to 900 revolutions.

Methods of feeding are broadly different from saw gins, because traveling spiked belt feeders usually supplement the drum or extractor feeding units. Rates of feeding are very slow. Outturns of 1 to 3 pounds per hour of ginned lint per inch of roller length are normal. Thus, under best conditions a 40-inch roller gin should gin from 100 to 120 pounds of fiber.

In foreign countries the customary methods for handling roller-ginned lint are usually very crude, the fiber being carried by hand to the press, a single-box type. There are, however, pneumatic means available for lint-flue conveyance of the fiber to a press. One form of this improved handling, fully pneumatic, has been developed by the Cotton Ginning Research Laboratories of the United States Department of Agriculture. Another conveyor type that uses a belt and airblast nozzle jet has been developed by a ginning machinery manufacturer in the United States.

Lint Cleaners

In 1938 the United States Cotton Ginning Research Laboratory began a series of studies of the possibilities of utilizing existing cotton mill fiber-cleaning equipment at the cotton gin to follow the gin-stand operations. The goal sought in this work was to develop a cleaner to operate at gin-stand capacity, clean without nepping or damaging the fiber, hold down the loss of usable fibers, improve grade enough to make the process pay, and consume as little power as possible. After thorough investigation, the saw-type lint cleaner was adopted and found to meet the necessary requirements satisfactorily and to be more effective in improving the grade of cotton than seed-cotton conventional types of cleaners or cotton mill Buckley-type beaters.

Grade improvement that may be derived from lint cleaning is dependent on the amount and type of foreign matter present in the seed cotton and the amount of seed-cotton cleaning equipment employed ahead of the gin stands. Ordinarily, a grade improvement of one-third to two-thirds may be expected.

Staple length of the cotton is not affected by the lint-cleaning process.

The weight of lint-cleaner trash on a bale basis is small as compared with the weight of trash removed by the seed-cotton cleaning equipment. The lint-cleaner trash, however, is comprised principally of small leaf particles, pepper trash, dirt, motes, and short irregular fibers that would lower the grade if left in the cotton. The average weight of waste removed by the lint cleaner will range from 3.5 pounds per bale on clean hand-picked cotton to about 18 pounds on late-season trashy cottons. Approximately 2 pounds of short, irregular fibers per bale are removed, regardless of the foreign-matter content. Recent ginning field studies show that the amount of good fiber lost in the lint-cleaner trash may at times be somewhat higher on rain-grown cotton than on irrigated cotton in western Texas and western Oklahoma.

Spinning tests showed that the foreign matter removed by the lint cleaner lowered the manufacturing waste. Yarn skein strength, yarn appearance, and the number of neps in the card web were not affected by lint cleaning.

The saw-type lint cleaner is being installed in many gins in lieu of some overhead seed-cotton cleaning equipment, to provide higher grades for machine-picked and roughly harvested cottons without damaging fiber properties and spinning quality. The cleaner is designed specifically for cleaning cotton in the lower grade ranges. Although grade benefits are realized on high-grade cotton when the lint cleaner is used, there is little net gain in bale value. Generally speaking, it has not been advisable to clean lint cotton of Strict Middling and higher grades, since the bale-weight loss will generally offset the increases in bale value associated with price increases.

In addition to the saw-type lint cleaners heretofore discussed (fig. 19), airjet, or pneumatic, types, developed by manufacturers, have been installed at a rapid rate in the irrigated section of the Cotton Belt and, to a lesser extent, elsewhere (fig. 20). One type may perform more satisfactorily in some localities from a grade-improvement and bale-weight-loss standpoint, while the other type may be preferable elsewhere because of regional or local variations in the varietal, growth, and harvesting factors.

Although the saw-type lint cleaner is generally more effective in improving grade of lint, it is also associated with a greater bale-weight loss. In recent studies the saw-type lint cleaner removed an average of 9.5 pounds per 500-pound bale for the season, as compared with 5.2 pounds for the airjet lint cleaner. Only during the late season was the net bale value increased as a result of grade improvement of the saw-type lint cleaner. The airjet lint cleaner increased the average bale value significantly during both the early-season and late-season ginning periods.

The installation of lint cleaners represents a relatively large investment on the part of the ginner. With an annual volume of 3,500 or more bales, the additional cost of lint cleaning is approximately $1 per bale. This includes an average of 20 to 40 additional horsepower, which is required to operate lint cleaners and their accessories in a 4-stand gin.

Fans and Cotton Piping

Several types of fans are used in cotton ginning, the majority having a single inlet and being fully housed with cast-iron or sheet-metal scrolls in which bladed wheels of various designs revolve (fig. 21). Size designations for cotton-gin fans are somewhat confusing, because each manufacturer employs his own reference nomenclature. Many fans, however, are designated simply by sizes from No. 30 to No. 50, which, in a general way, indicates the number of hundreds of cubic feet of air that the fan will deliver per minute. When the fan wheel has open, straight blades, it is called plain wheel (fig. 21, *A*). This type is usually sufficiently sturdy to handle trash and foreign matter directly through the wheel. However, when both main wheel and stub blades are shrouded and made of lightweight materials (fig. 21, *B*), they are readily damaged by foreign matter and should be used only for handling normally clean air.

Numerous gin installations use rembert-type wheels (fig. 21, *C* and *D*). The Cotton Ginning Research Laboratory cone fan (fig. 21, *D*) does not crack dry seeds. The perforated steel shields used in both types of rembert wheels permit the

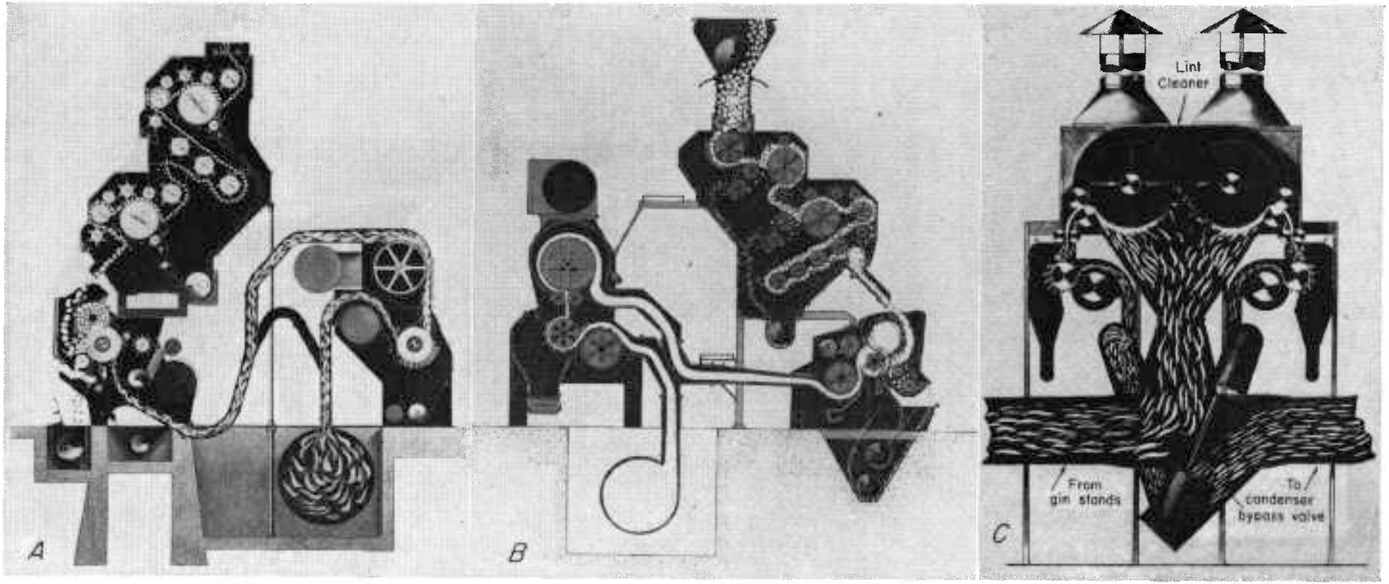

Figure 19.—Saw-type lint cleaners: *A*, Flow-through type, designed by the Cotton Ginning Research Laboratory (courtesy The Murray Co. of Texas, Inc.); *B*, condensed-batt type with feeding mechanism to saws (courtesy Continental Gin Co.); *C*, master lint cleaner to serve entire cotton gin (courtesy Moss-Gordin).

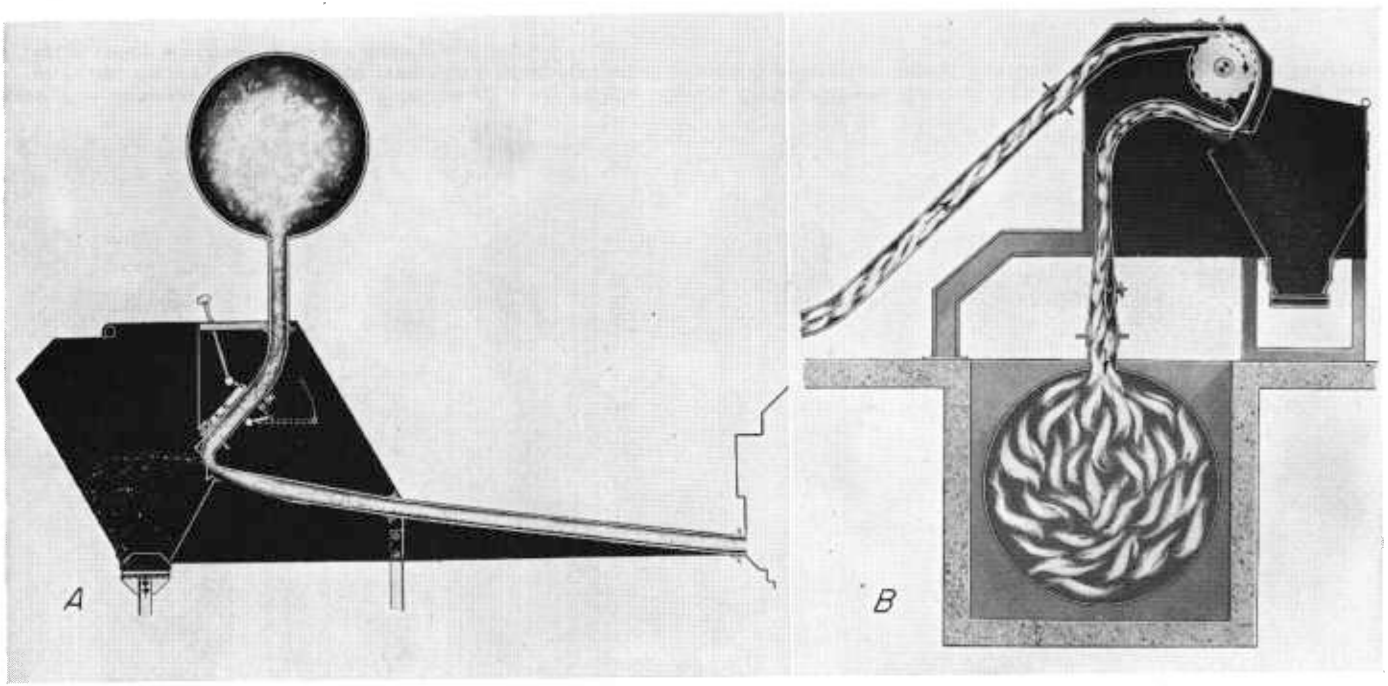

Figure 20.—**Pneumatic-type lint cleaners: *A*, Super-jet; *B*, air centrifugal.**

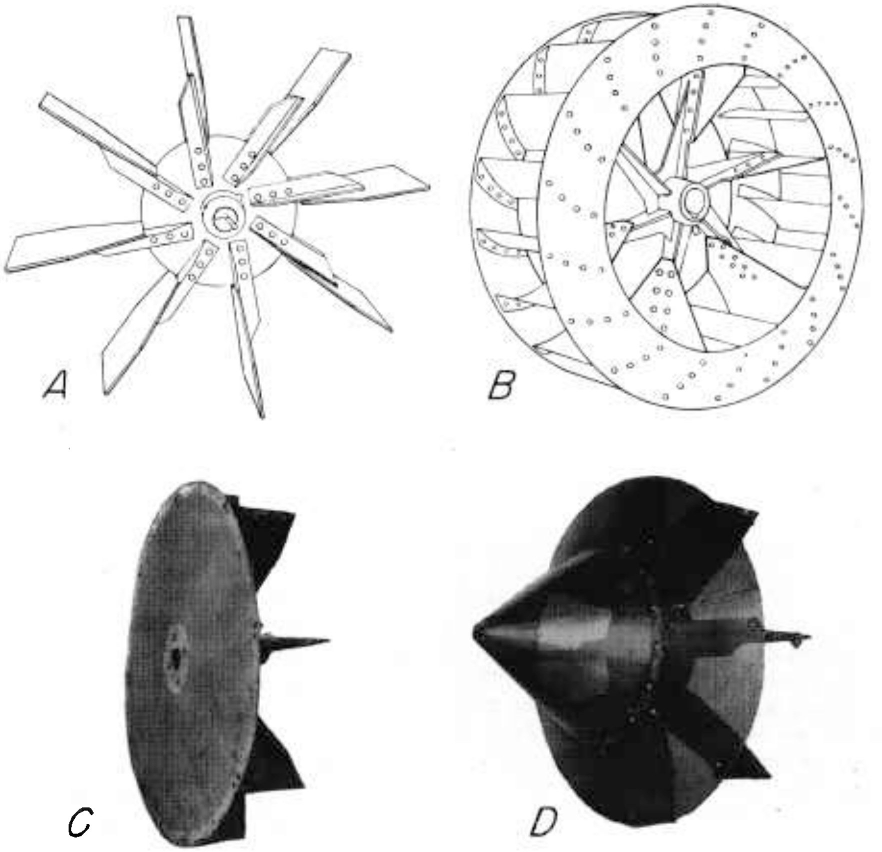

Figure 21.—**Cotton-gin fan wheels: *A*, Plain, straight blade; *B*, multiblade, shrouded; *C*, rembert-type flat disk; *D*, rembert-type Cotton Ginning Research Laboratory cone.**

air to pass through while the seed cotton is diverted to the fan outlet without striking the blades of the fan. Wheels of all the rembert types are necessarily from 3 to 4 inches narrower than the casing, so that there may be no choking in the throat between the disks and the front of the fan. Rembert-type fans are very convenient for unloading seed cotton into storage bins or for transferring it from bins to gin. They are also used with various kinds of cotton driers.

Fans used in cotton gins are connected to systems of galvanized sheet-metal piping, ranging from No. 24 to No. 18 gage. This piping varies from 6 to 16 inches in diameter. In these pipes the air velocities may range from 2,500 to 5,000 feet per minute. Freshly ginned dry seed can seldom be handled at air velocities greater than 4,200 feet per minute in piping without damaging the seed. As a result of the relatively high velocities and pressures that are encountered in ginning operations, the fans may require 60 percent more of the total power consumption of the gin. Consequently, inefficient fan or piping systems are costly in operation.

Each fan should be carefully selected. Ball-bearing fans are preferable to the older types with babbitted bearings. All types must be given regular attention and oiling for satisfactory service. The designs of inlet and outlet adapters to

and from fans are important in obtaining the best results from any pneumatic system. State and Federal extension ginning specialists, as well as engineers of both machinery manufacturers and power companies in most cotton-growing States, have instruments for measuring fan speeds, volumes, and pressures. From these data they can determine how to obtain the best performance at lowest power costs.

It is now possible, by the careful selection of a fan, to obtain any 1 of 3 capacities [3] merely by changing the wheel size within the casing. This affords many advantages to the ginner who may require a greater volume of air when new apparatus replaces old units. In selecting rembert-type fans, it is desirable to obtain oversize units, in order to avoid excessive speeds. Thus a size 45 casing with a size No. 40 rembert-type wheel and disk is a very popular unit for cotton-storage houses, while a size 50 casing with a No. 45 cone and wheel has become the largest standard for certain types of cotton-drying installations. The safe tip speeds of both rembert-type and regular gin-type fan wheels usually ranges between 10,000 and 15,000 feet per minute, although straight-blade forged steel fan wheels may go somewhat faster.

Cotton piping is customarily constructed with slip joints and bolted bands. Although elbows are available in either 5 or 7 sections, the longer radius elbows of 7 sections are usually better for reducing pressure resistance and avoiding impact damages to seed. Suction telescopes for use with motortrucks, storage houses, and overflow bins are included in cotton-piping work, and several forms of flexible joints are now available. As a general rule, telescopes should be counterweighed, so that they operate freely and so that they will be approximately 7 feet above the scales platform or runway floor when they are not in use.

Improved cotton-gin piping not only involves the use of correctly designed adapters, elbows, and other fittings where connections are made to apparatus, but the ends of discharge pipes of all kinds should be also fitted with megaphonelike sections that tend to reduce pipe losses and that also produce full volumes of air flow.

Condensing, Pressing, and Baling

The ginned lint is blown from the gin saws through the lint flue to the condenser by the air current created by the brushes of brush gins or by the air from the blast fan of airblast gins. The lint flue should be properly proportioned and should contain no obstructions such as rivet heads or rust to accumulate lint and dust. The continuous current of air in the lint flue takes the lint to a condenser which separates the lint from the air.

Condensers employ either 1 or 2 slow-turning screened drums upon which the ginned lint forms a batt. The batt is discharged between doffing rollers to a lint slide that delivers it to the press boxes. Venting the air from the condenser, as the air is separated from the lint, is usually accomplished through the screened drum to its ends and thence in direction as provided in the makers' designs. The free areas of the condenser screens and vents should exceed that of the lint-flue system, in order to prevent resistance or backlash, which causes chokes. Diameters of conventional condenser drums with working lengths of 54 inches range between 3 and 8 feet to suit the number of gin stands. The turns of the drums vary from 6 to 12 per minute. Figure 22

[3] This does *not* apply to rembert-type fans.

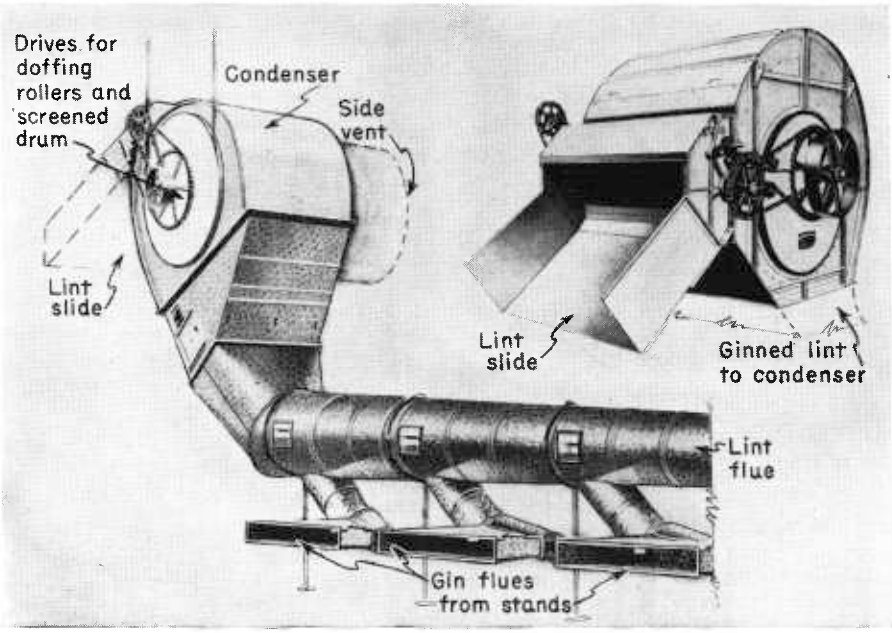

***Figure 22.*—Left-hand discharge condensers showing partial flue system and condenser with vent and slide dotted, and lint slide and drives of drum and doffing rollers.**

shows two designs of condensers having side vents.

Cotton is packaged at the gin usually in the rectangular, or so-called square, bale weighing about 500 pounds gross. Uncompressed, this bale measures approximately 54 by 27 by 45 to 48 inches. Standard compressed (or standard-density) bales and high-density bales are made by compressing the square gin bales. The high-density bale is narrower and more symmetrical than the standard bale. The standard bale usually measures 56 by 28 by 18 to 22 inches, and the high-density bale is 59 by 24 by 19 inches. Approximately 6 yards of bagging, weighing usually 1¾ to 2 pounds per linear yard, is used to cover each bale.

Cotton presses at the gins may be either the single- or the double-box type and use screw, steam, or hydraulic power. The hydraulic press is generally considered the most desirable (fig. 23). From 40 to 60 tons of pressure is usually applied to the cotton by the press ram in making low-density or flat bales. Heavy-duty gin presses that apply up to 250 tons per bale are now available for enabling gins to produce a standard-density gin compress bale at approximately 25 cents (1954 prices) more than the cost of a flat, or uncompressed, bale.

The packaging of American cotton has never been wholly satisfactory either in protecting the cotton or in economy in handling. The materials and methods of covering are controversial subjects. Prevalent practice is to use jute bagging, flat steel ties and buckles with a total tare weight of approximately 21 pounds. This allows 9 pounds for the buckles and ties, and 12 pounds for bagging.

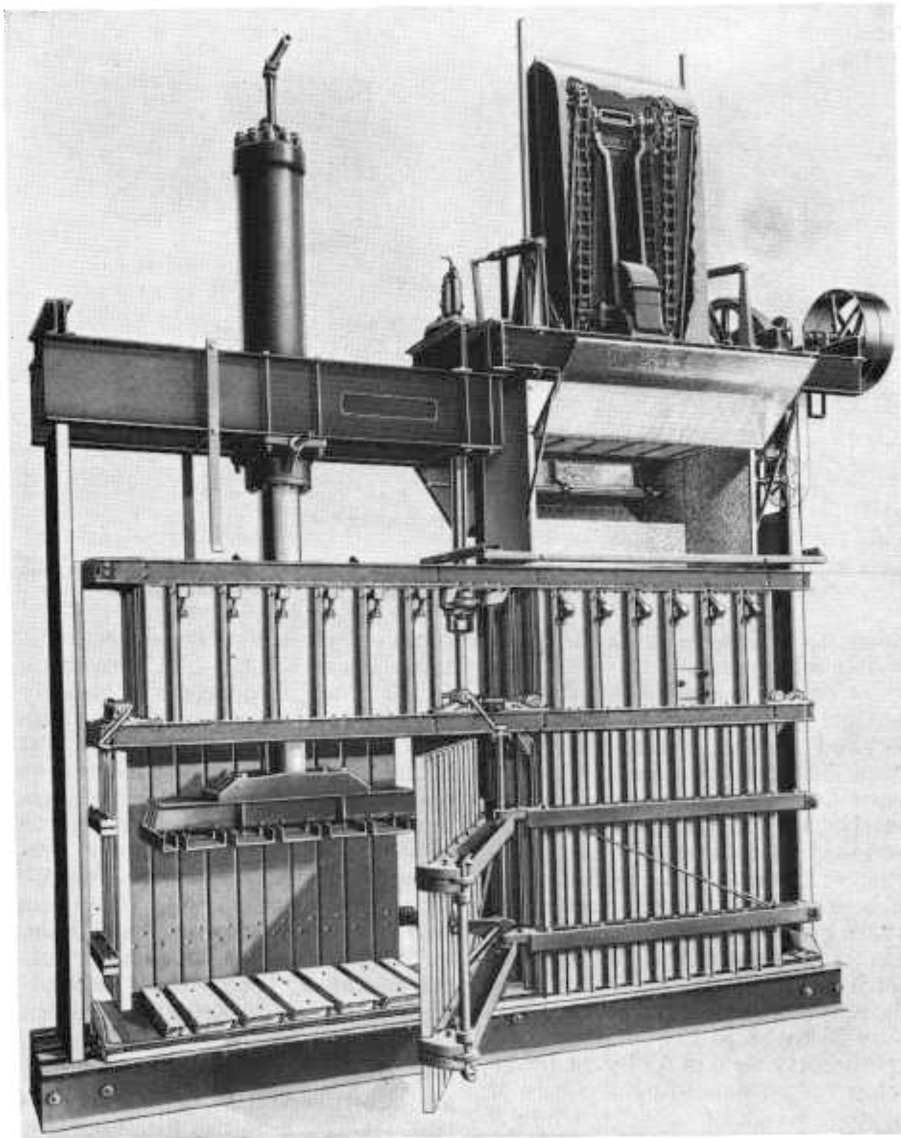

Figure 23.—Down-packing, single-story, double-box, all-steel hydraulic cotton press. (Courtesy The Lummus Cotton Gin Co.)

Planning and Equipping New Ginning Plants

The best planned gin is adequate for the regional needs and sufficiently flexible to operate economically on either clean hand-picked or roughly harvested cottons, under adverse seasonal conditions (see figs. 10 to 14).

Special drying, cleaning, and extracting apparatus at the larger cotton gins is often set up with its own power service as an annex to the main gin. The annex generally is placed at ground level and thus is connected by simple piping to the existing machinery. This affords a minimum of expense and new construction. A plant having four 80-saw gin stands with good machinery-processing accessories can readily handle 7 bales of spindle-picked cotton per hour with medium seed roll. Thus, each gin saw, when operating continuously and efficiently, can gin out approximately 9 to 11 pounds per hour and produce a satisfactory sample.

Figure 14 illustrates systems where the modern trend is to keep most of the so-called "overhead machinery" at the ground level. Figure 24 shows conventional stacking vertically of somewhat elaborate equipment, so that "overhead machinery" is actually overhead. Such overhead arrangements are possible where the building height and width are ample. For safety and better accessibility the ground level groupings are preferable.

Large-volume cotton gins frequently resort to double-battery layouts in which each ginning side faces a central aisle. Two different kinds of harvesting may be concurrently handled, because each side has its own press and overhead, or annex, equipment. For medium-volume conditions, the 3-stand battery on each side has numerous advantages in economy of power, availability of units, and suitability for conventional building construction. Thus, a double battery of three 90-saw gin stands with drying, cleaning, and extracting apparatus has many advantages over a single 5- or 6-stand battery of ginning units. It is common in the larger single-battery units to use duplex overhead equipment with a single separator of sufficient width to permit dividing equally the incoming bulk stream of seed cotton to serve each line of cleaning and extracting apparatus.

Power requirements for each gin stand and its share of accessories will range from 60 to 100 horsepower, depending upon the elaborateness of equipment. Increased services rendered by cotton gins in drying, cleaning, extracting, and lint cleaning may increase the electric power consumption from 30 to 65 kilowatts per bale. It is important, therefore, that the selection of motors, drives, and loads per motor should be carefully calculated and planned.

The building should be all steel or other form of fireproof construction. It should have a plate height of not less than 24 feet and a working width of not less than 30 feet for a single battery gin, or 46 feet or more for a double battery. It is generally advisable to locate the seed scales and platform bale scales in the ginning building at the place most convenient to the ginner where at one counter he may weigh incoming loads, weigh seed, and make out the gin tickets.

Engines and fans should be placed in separate compartments from the ginning machinery to eliminate noise and to protect the power machinery from grit and dust. This separation also helps to reduce accidents.

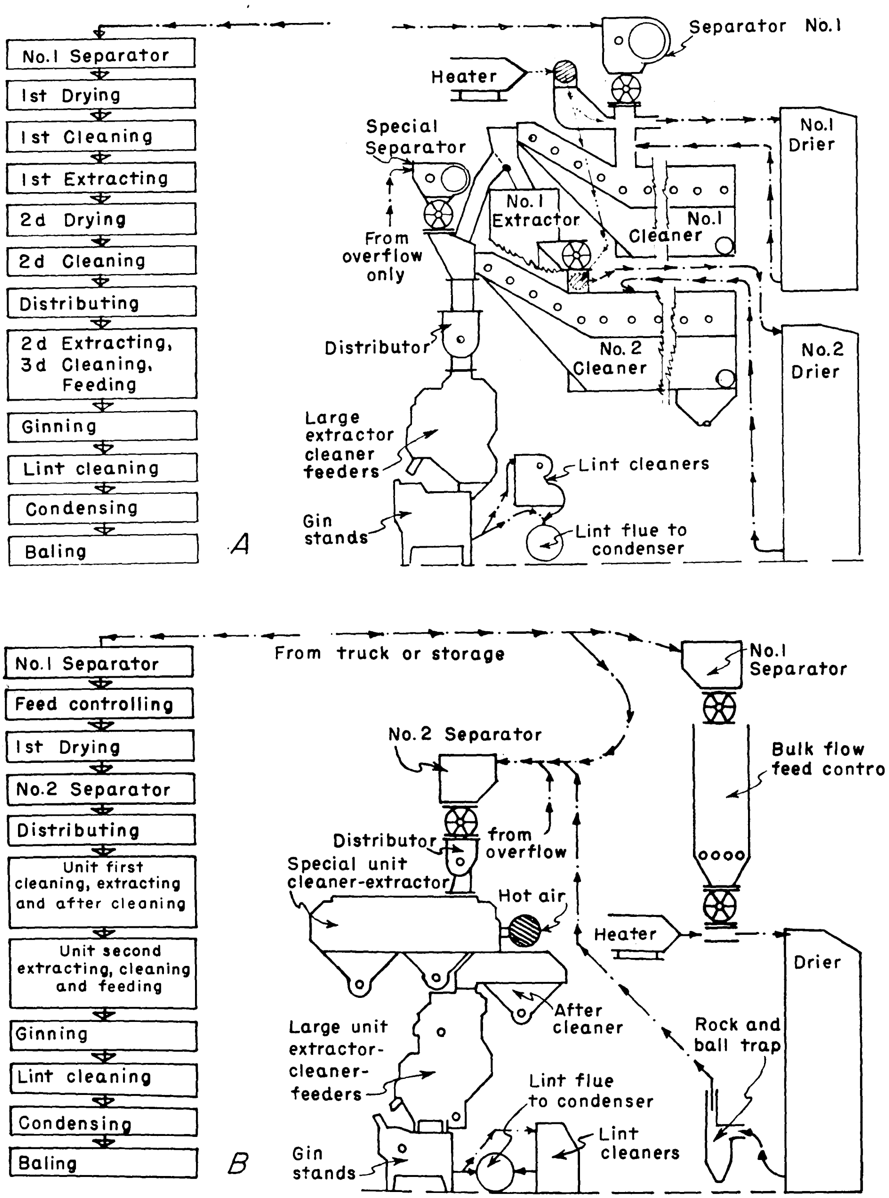

***Figure 24.*—Cotton ginning machinery in elaborate arrangements: *A,* With major portion of equipment above the distributor; *B,* with major portion below the distributor.**

Intensive research investigations by the Department of Agriculture regarding static electricity phenomena at cotton gins have reduced insurance rates by eliminating previous requirements for grounding of machinery, and by using recently approved fire prevention means to combat fires.

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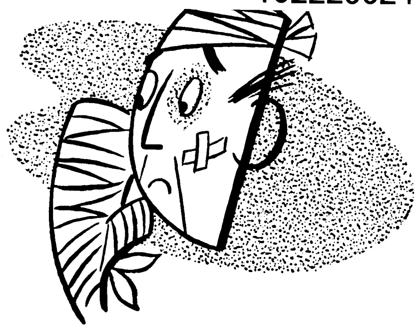
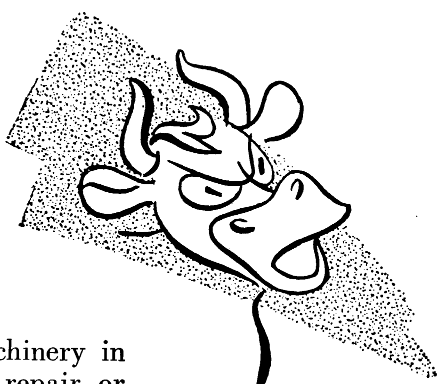


Farm Accidents Each Year . . .

Kill about 15,000 people.

Injure or cripple about $1\frac{1}{4}$ million more.

Cause loss of 17 million man-days of farm labor, or the services of 46,000 men working every day for a year.



Help Prevent Most of These Accidents!

Keep tractors and other farm machinery in good repair. Equipment in bad repair or carelessly handled ranks first in killing or injuring farm people.

Handle bulls and other farm animals carefully. They rank second in causing farm accidents and deaths.

Use sharp-edged tools with caution—sickles, saws, corn knives, chisels, screwdrivers, axes.

Take proper care in using, handling, and storing insecticides and other poisonous chemicals.

Install, use, and repair electrical appliances and equipment properly.

You can lessen the seriousness of many accidents by immediate and proper care. Keep a first aid kit handy and know how to use it. **Call a doctor.**